

WATER 101

Just the basics!

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Goals

- Gain familiarity with basic water terms and concepts
- Tailor this presentation to what YOU need to know
- Develop a list of further questions to cover at a future Advisory Committee session

Purpose: Background for work of the ESPA Advisory Committee

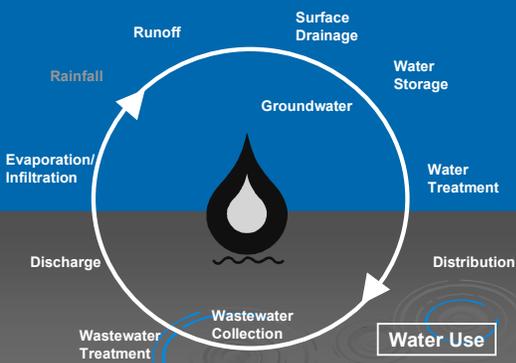
Outline

- Hydraulics
- Units and Terms
- Water Quality Parameters
- Municipal Engineering
 - Water Treatment and Distribution
 - Wastewater Collection and Treatment
- Groundwater and Aquifers
- Hydrology
- Water Storage
- On-Farm Water Use
- Models and Scenarios
- Discussion: Other possible topics

Engineer Fashion



Diane's Circle of Water



Basic Hydraulics



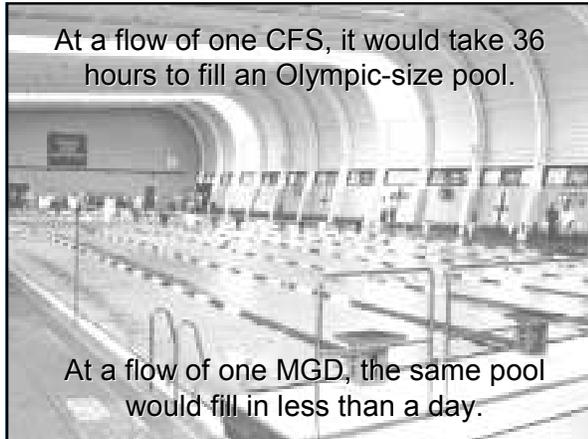
Units and Terms

- Flow – CFS, MGD
- Volume – AC-FT, ft³
- Area – acre, hectare, square mile
- General
 - Topography, right-of-way, easement, GIS
- Terms explained in each section

Flow: One CFS fills 8 1/3 bathtubs in one minute



At a flow of one CFS, it would take 36 hours to fill an Olympic-size pool.



At a flow of one MGD, the same pool would fill in less than a day.

Boulder Creek at 900 cfs, May 28th, 2003



What is the flow now?

One cubic foot is equivalent to 7.5 gallons



Volume: One AC-FT is equivalent to three Olympic-size swimming pools



One acre is enough space to park 230 cars.



Basic Water Quality Parameters

- > Vocabulary
 - Pathogens, TSS, TDS, precipitate, concentration, invasive species, contamination/pollution
- > Color and Clarity
- > Temperature
- > Current and Flow
- > Dissolved Oxygen
- > pH
- > Pollutants
- > Pathogens

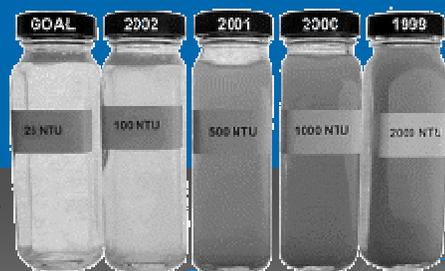
Main Entry: **pol-lute**

Function: *transitive verb*

1 a : to make ceremonially or morally impure : **DEFILE** **b** : **DEBASE**

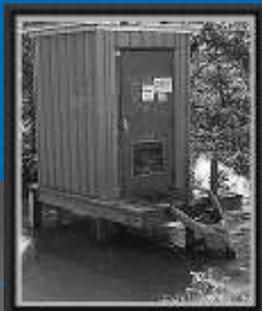
2 a : to make physically impure or unclean : **BEFOUL**, **DIRTY** **b** : to contaminate (an environment) especially with man-made waste

Color, Clarity and Temperature

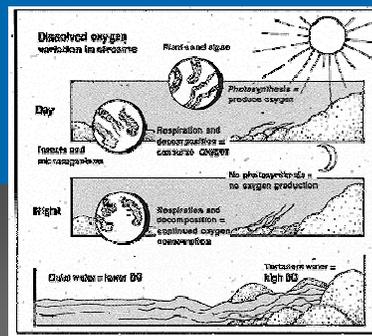


Current and Flow

- > [USGS Real-time stream data](#)



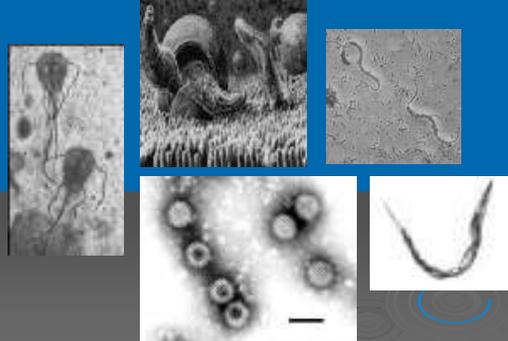
Dissolved Oxygen and pH



Pollutants

- Petroleum Products
- Detergents
- Nitrate and Phosphate
- Heavy Metals
- Fecal Coliform

A plethora of pathogens



Water Quality Affects Plant and Animal Life

- Sediment
- Excess nutrients
- Low dissolved oxygen
- Bacteria and other pathogens
- Trash
- Hazardous waste

Not suitable for contact recreation

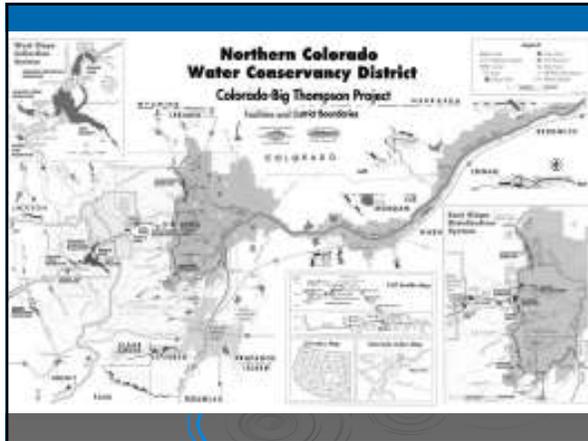


Municipal Engineering – Water Treatment

- Vocabulary
 - Flocculation, Non-revenue water
- Boulder's Water Sources
- The Water Treatment Process
- Distribution Systems

Boulder's Water Sources

- Seven Reservoirs in the Silver Lake/Lakewood Watershed (North Boulder Creek) – **40%**
- Barker Reservoir (Middle Boulder Creek) – **40%**
- Boulder Reservoir – **20%**



The (Engineered) Water Treatment Process

- May include:
 - Sedimentation
 - Aeration
 - Mixing, flocculation, settling
 - Softening
 - Filtration
 - Adsorption
 - Disinfection
 - Storage

Water Distribution Systems

- Sizing Water Pipes
- Maintaining Water Pressure
- What happens to water in the pipes?

Municipal Engineering – Wastewater Treatment

- Vocabulary
 - Organic and non-organic; aerobic and anaerobic; BOD; COD; total coliform; primary, secondary and tertiary treatment; effluent
- What's in the sewer?
- Stages in wastewater treatment
- Boulder's Wastewater Treatment Facility
- Collection systems
- Septic Systems

What's in the sewer?

- Dissolved and suspended solids
- High BOD
- High COD
- Nitrogen
- Phosphorus
- Grease
- Pathogens
- Heavy Metals

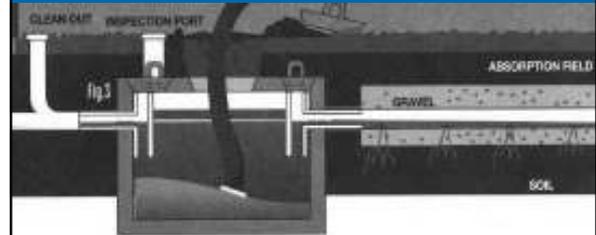
Stages in Wastewater Treatment

- Screening }
 - Settling }
 - Biological Treatment }
 - Disinfection }
 - Further Solids Removal }
 - Nutrient Removal }
 - Sludge Treatment and Disposal

Boulder's Wastewater Treatment Facility

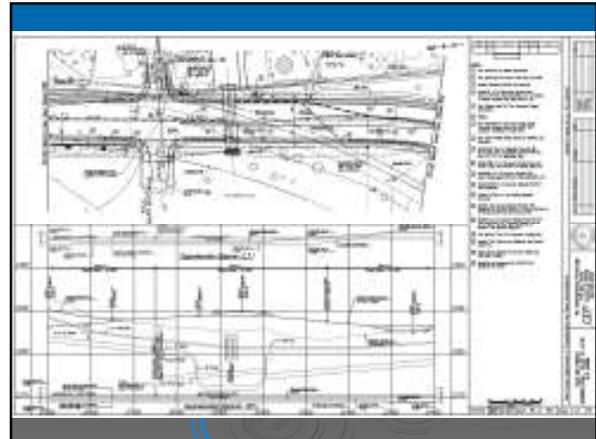


Septic Tanks



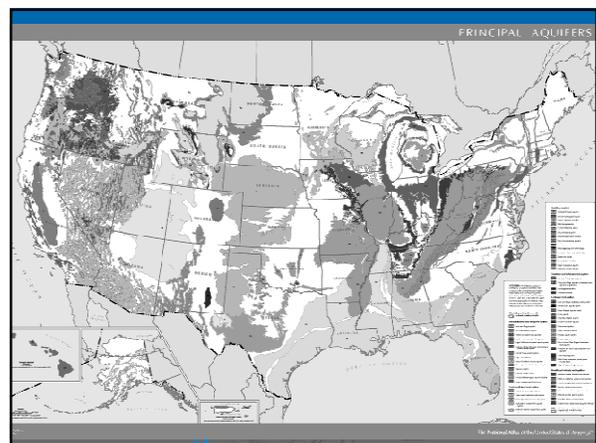
Wastewater Collection System

- Gravity lines
- Force mains
- Pump Stations
- Separation Distances
- Deep trunk sewers

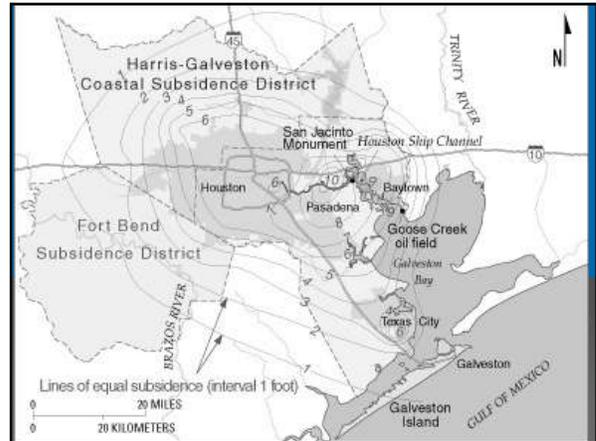
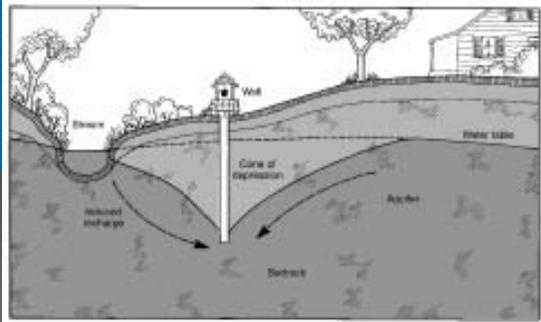


Groundwater

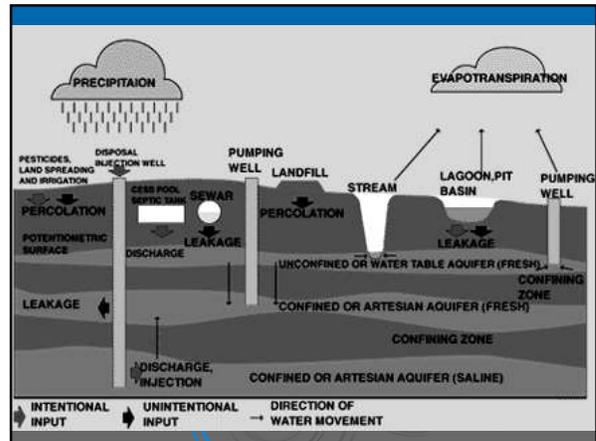
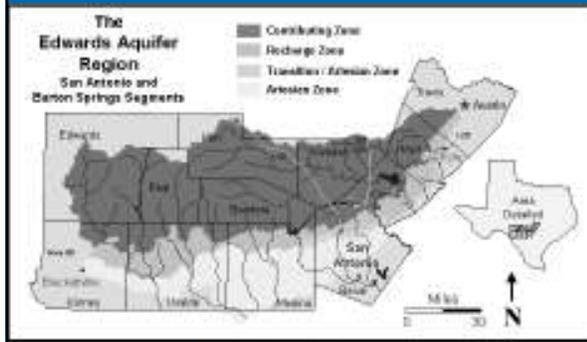
- Vocabulary
 - Aquifer; rechargeable vs. non-rechargeable; drawdown; subsidence; intrusion; plume
- Mapping groundwater
- How a well works
- Subsidence and salt water intrusion
- Linkage with surface water
- Groundwater contamination



How a Well Works



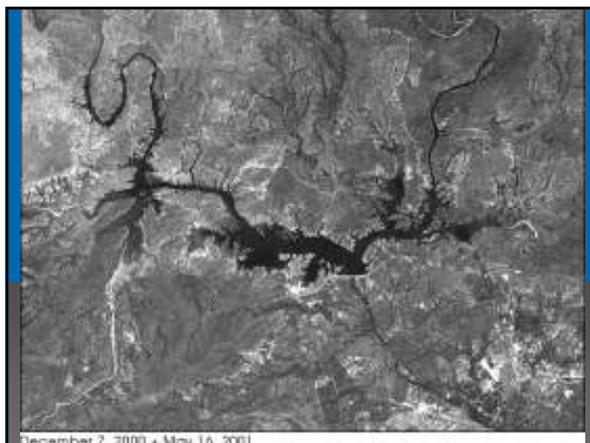
Edwards Aquifer and Recharge



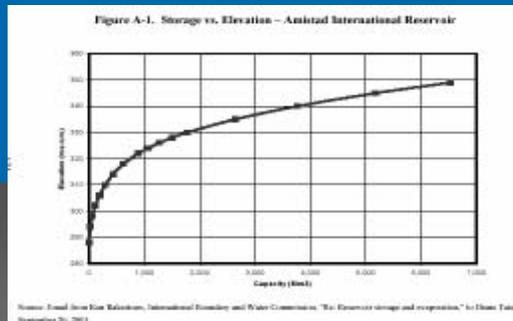
Water Storage

- Vocabulary
 - Storage-area-elevation data, dead storage
- Reservoir Storage
- Sedimentation
- Evaporation

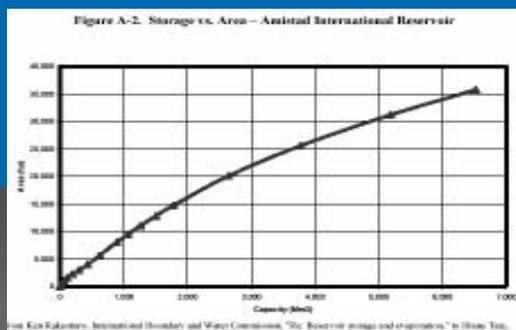




Storage-Elevation Curve



Storage-Area Curve



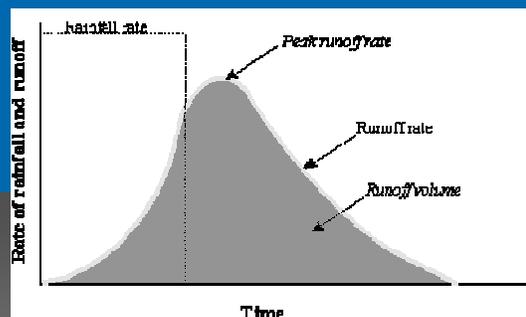
Sedimentation and Evaporation

- 45 cm of sediment per year – almost 1.5 feet
- Proportional to area: evaporation losses average 20% of reservoir inflows

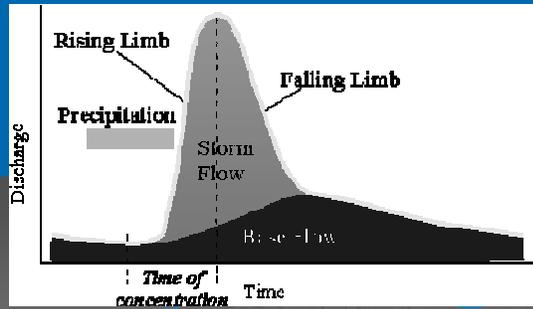
Hydrology, Surface Drainage and Floodplains

- Vocabulary
 - Alluvium, ephemeral, sheet flow, infiltration, evaporation, transpiration, playa lake, impervious cover, rainfall, runoff, hydrograph, floodway, floodplain
- Rainfall/Runoff Relationships
- Statistical Floods

Runoff Hydrograph

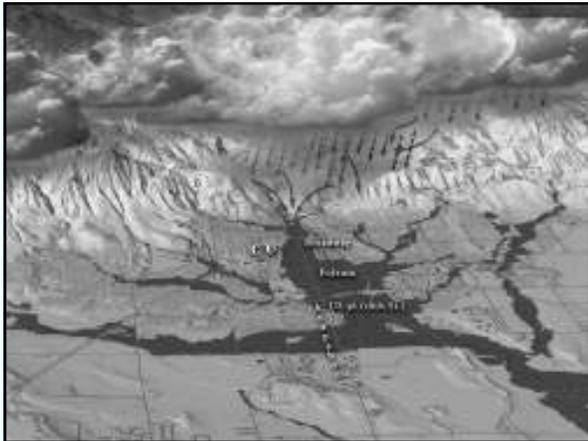


Streamflow Hydrograph



South Boulder Creek Flood Frequency Analysis

Return Period	Peak Flow Rate
2-Year	582 cfs
5-Year	990 cfs
10-Year	1350 cfs
20-Year	1780 cfs
50-Year	2490 cfs
100-Year	3140 cfs
200-Year	3930 cfs
500-Year	5200 cfs



On-Farm Water Use

- Vocabulary
 - Evapotranspiration (ET)
- Brainstorm questions for the next background session



Halley King, NASA, GFSQ



Credit: Ming Kei College, Hong Kong

Models and Scenarios

- What is a model?
- What are scenarios?
- Brainstorm questions for a future Advisory Committee Meeting

What is a model?

- “a miniature representation of something”
- “a set of statements describing a system that incorporates physical and non-physical elements, and helps explore relationships among elements”
- Incorporates static and dynamic elements
- Deterministic vs. stochastic

What is a scenario?

- A particular set of inputs to the model structure designed to answer a specific question
- Examples and analogies

Other Possible Topics ... What would you add?

- More on modeling and the ESPA Groundwater Model?
- More on agricultural water use?